DESCRIPTION

INITIATOR

TECHNICAL FIELD

The present invention relates to an initiator to be employed in, for example, an airbag apparatus or a seatbelt pre-tensioner, either of which is to be furnished in a vehicle.

BACKGROUND ART

One of various known types of initiators is constituted by a pair of electrodes joined together via an insulator; a bridge wire connected with these two electrodes and adapted to generate heat when energized; and a capsule accommodating the bridge wire and an explosive able to detonate in response to heat generation of the bridge wire. This type of initiator is disclosed in, for example, Japanese Patent Application Laid-Open (*kokai*) No. H11-301402.

In order to manufacture the above-described type of initiator compactly, the individual components of the initiator must be reduced in size, which results in a reduction in the usable amount of explosive (the amount of explosive that can be charged in the capsule). For this reason, conceivably, when the explosive is ignited for detonation in such a downsized conventional structure, there arises a fear that a desired level of flame propagation energy cannot be obtained in an intended direction.

DISCLOSURE OF THE INVENTION

To solve the above-mentioned problems, the present invention provides an initiator comprising: a pair of electrodes disposed with an insulator disposed therebetween; a bridge wire connected between the pair of electrodes and adapted to generate heat when energized; an explosive which detonates in response to heat generation of the bridge wire; a bottomed tubular capsule accommodating the bridge wire and the explosive; breakage inducing means for inducing breakage of a bottom wall of the capsule when the explosive is ignited for detonation, the breakage inducing means being disposed in a specific portion of the bottom wall of the capsule; and breakage restricting means for restricting progress of the breakage from the specific portion toward a sidewall of the capsule, the breakage restricting means being formed on the capsule.

In the initiator of the present invention, when the explosive is ignited for detonation, breakage of the capsule can be concentrated in the vicinity of the specific portion, so that flame propagation energy (pressure or flamepower) generated by detonation of the explosive propagates in an intended direction through the broken portion. Therefore, even if the amount of the explosive charged in the capsule is small, an intended magnitude of flame propagation energy can be attained in an intended direction upon detonation of the explosive. Accordingly, it is possible to reduce the size of the initiator while maintaining the function of the initiator.

Preferably, the breakage restricting means includes strength increasing means for increasing the strength of the bottom wall gradually from the specific portion toward the sidewall. The strength increasing means may includes a variation in thickness of the bottom wall such that the thickness increases gradually from the specific portion toward the sidewall.

The bottom wall has a protrusion projecting outward from the bottom wall and having a corner portion of substantially right angle. The protrusion may be offset from a center of the bottom wall of the capsule.

Further, the strength increasing means may include a plurality of recesses formed in the bottom wall in a varying density decreasing gradually from the specific portion toward the sidewall; or a plurality of discrete grooves formed in the bottom wall and arranged between the specific portion and the sidewall. The grooves may be annular grooves arranged concentrically around the specific portion.

Still further, the strength increasing means may include a continuous non-linear groove extending from the specific portion toward the sidewall. The depth and/or width of the groove may be decreased gradually from the specific portion toward the sidewall.

According to there preferable feature, progress of the breakage of the bottom wall of the capsule from the specific portion toward the sidewall of the capsule can be restricted reliably. Further, the strength of the bottom wall of the capsule can be gradually increased from the specific portion toward the sidewall of the capsule through employment of a simple construction.

In the case of the bottom wall has a protrusion projecting outward from the bottom wall, because flame propagation energy generated by detonation of the explosive can be guided to the end wall portion of the protrusion, the magnitude of the flame propagation energy in an intended direction can be increased. In the case of the protrusion is offset from a center of the bottom wall of the capsule, the intended direction of propagation of the breakage can be adjusted by adjusting the offset

distance.

When the present invention is practiced, the breakage restricting means includes a layered structure of the capsule such that the number of layers at the specific portion is smaller than that at the remaining portions. By virtue of this feature, the strength of the bottom wall of the capsule can be varied reliably from the specific portion toward the sidewall of the capsule by changing the number of layers, and hence an intended strength can be obtained properly.

Preferably, the specific portion is a center of the bottom wall of the capsule. By virtue of this feature, flame propagation energy can be propagated while being concentrated in a direction corresponding to the center of the bottom wall in the capsule. Preferably, the breakage inducing means includes a recess formed in the specific portion of the bottom wall of the capsule. By virtue of this feature, the breakage inducing means can be achieved through employment of a simple construction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view showing an inflator for an airbag apparatus to be mounted in a vehicle in which inflator an initiator according to an embodiment of the present invention is employed;

FIG. 2 is an enlarged cross-sectional view of a main portion of the initiator of FIG. 1;

FIG. 3 is an enlarged cross-sectional view of a main portion of an inner capsule alone, which is shown FIGS. 1 and 2;

FIG. 4 is a schematic cross-sectional view of a first modification of the inner capsule of FIG. 3;

FIG. 5 is a schematic cross-sectional view of a second modification of the inner capsule of FIG. 3;

FIG. 6 is a schematic cross-sectional view of a third modification of the inner capsule of FIG. 3;

FIG. 7 is a bottom plan view of the inner capsule of FIG. 6;

FIG. 8 is explanatory view illustrating transitional stages of breakage of the inner capsule of FIGS. 6 and 7; and

FIG. 9 is a schematic cross-sectional view of a fourth modification of the inner capsule of FIG. 3.

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will now be described with the drawings. FIG. 1 shows an inflator 10 for an airbag apparatus to be mounted in a vehicle, the inflator 10 incorporating an initiator 20 according to the present invention. The inflator 10 of the present embodiment includes a casing 11 and a breakable gas sealing lid 12 mounted in an airtight manner in the casing 11. The casing 11 has a gas storage portion 11a, in which a high-pressure gas is enclosed, and an attachment portion 11b, to which the initiator 20 is attached.

While in an unbroken state, the gas sealing lid 12 serves to reserve a high-pressure gas in the storage portion 11a of the casing 11. Notably, when the gas sealing lid 12 is broken upon detonation of the initiator 20, the high-pressure gas spurts out of the gas storage portion 11a of the casing 11 toward an airbag (not shown) via an outflow opening 11b1 formed in the attachment portion 11b.

Meanwhile, the initiator 20 includes a plurality of components shown,

CLAIMS

1. An initiator comprising:

a pair of electrodes disposed with an insulator disposed therebetween;

a bridge wire connected between the pair of electrodes and adapted to generate heat when energized;

an explosive which detonates in response to heat generation of the bridge wire;

a bottomed tubular capsule accommodating the bridge wire and the explosive;

breakage inducing means for inducing breakage of a bottom wall of the capsule when the explosive is ignited for detonation, the breakage inducing means being disposed in a specific portion of the bottom wall of the capsule; and

breakage restricting means for restricting progress of the breakage from the specific portion toward a sidewall of the capsule, the breakage restricting means being formed on the capsule.

2. An initiator according to claim 1, wherein the breakage restricting means includes strength increasing means for increasing a strength of the bottom wall gradually from the specific portion toward the sidewall.

3. An initiator according to claim 2, wherein the strength increasing means includes a variation in thickness of the bottom wall such that the thickness increases gradually from the specific portion toward the sidewall.

4. An initiator according to claim 2 or 3, wherein the bottom wall has a protrusion projecting outward from the bottom wall and having a corner portion of substantially right angle.

5. An initiator according to claim 4, wherein the protrusion is offset from a center of the bottom wall of the capsule.

6. An initiator according to claim 2, wherein the strength increasing means includes a plurality of recesses formed in the bottom wall in a varying density decreasing gradually from the specific portion toward the sidewall.

7. An initiator according to claim 2, wherein the strength increasing means includes a plurality of discrete grooves formed in the bottom wall and arranged between the specific portion and the sidewall.

8. An initiator according to claim 7, wherein the grooves are annular grooves arranged concentrically around the specific portion.

9. An initiator according to claim 2, wherein the strength increasing means includes a continuous non-linear groove extending from the specific portion toward the sidewall.

10. An initiator according to claim 7, 8 or 9, wherein the groove or grooves decrease in depth gradually from the specific portion toward the sidewall.

11. An initiator according to claim 7, 8, 9 or 10, wherein the groove or grooves decrease in width gradually from the specific portion toward the sidewall.

12. An initiator according to claim 1, wherein the breakage restricting means includes a layered structure of the capsule such that the number of layers of the capsule at the specific portion is smaller than that at the remaining portions.

13. An initiator according to any one of claims 1 to 12, wherein the specific portion is a center of the bottom wall of the capsule.

14. An initiator according to any one of claims 1 to 13, wherein the breakage inducing means includes a recess formed in the specific portion of the bottom wall of the capsule.